Vol XVIII
No. 1

ISSN 0019-5014

CONFERENCE
NUMBER

JANUARY-
MARCH
1963

INDIAN JOURNAL OF AGRICULTURAL ECONOMICS

INDIAN SOCIETY OF
AGRICULTURAL ECONOMICS,
BOMBAY

SOME ASPECTS OF THE ECONOMICS OF CROPPING PATTERN A STUDY OF CONDITION IN THE DISTRICT OF MONGHYR, BIHAR

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I

The question of cropping pattern can be considered in a wider perspective of combination of activities leading to diversification or specialization in agriculture. It has importance both from the point of view of the individual farm and the nation as a whole. In the former case, it is a question of combination of crops to be grown on limited farm or land area and with given quantities of labour, capital and management resources. In the latter case, it is a problem of determining the pattern to be encouraged through national programmes. Thus there are two issues : the maximization of individual farm profits and the most efficient utilization of the nation's resources. For the present we proceed on the assumption that there is little conflict between the two. Apart from the central objective of diversification or specialization in crop production, labour capacity and employment are factors which have a great deal of relevance to the question.

In the case of a small family farm it is natural that the volume or the nature of its crop enterprise will be largely determined by the number of its own workers, *i.e.*, the family labour force. Larger the capacity of the family labour force, the larger will be the quantity of crop enterprise. This is particularly because land is limited here compared to the size of the family labour force. It is the capacity of the family labour which sets the limit to farm enterprise. In this paper we shall attempt to analyse the cropping pattern of Bihar which is typically a multi-crop region in terms of the family labour and farm-size capacity.[1]

II

Some Indicators of Labour Capacity

We have made use of two possible indicators to assess labour capacity. The first is the difference between the extent of area leased-in and leased-out. This is

N. B. Detailed Tables giving data on which this paper is based have not been appended to save space.

1. Data used are from Farm Management Investigation in Monghyr (Bihar), 1958-59, conducted by the Agro-Economic Research Centre, Visva-Bharati University and sponsored by the Union Ministry of Food and Agriculture, Government of India.

conceived on the premise that farms tend to lease-in lands as long as the family working force permits them to carry out the farm business in view. The point where excess of leasing-out lands over leasing-in emerges is also the point of fullest utilization of the family labour force or, in other words, this is the full capacity point for family labour. Further multiplication of crops or increase in farm activities beyond this point would require employment of hired labour or overstretching of family labour at the cost of efficiency. Diversification in such cases in terms of number and nature of crops has a labour capacity implication. In brief, the character of the first indicator is such that it may be better termed an indirect measure of labour capacity. The second measure is more direct and precisely an attempt to ascertain the cropping pattern (or the number of crops grown) for a certain farm size group upto which the intended farm activities can be conducted with little or no hired labour in the off-agricultural season. On the other hand, due to the seasonal character of agricultural operations labour has to be hired in the peak season to cope with increased activities but even in this season the extent of hire may provide some indication as to the point of labour capacity. The extent of hired labour used in both season depending on their relative importance may, therefore, enable us to arrive at the point in the cropping pattern which corresponds to labour capacity.

Question of Returns

When thus the question of labour capacity has been highlighted, it is germane to consider a second question which automatically comes after the first. It is farm employment provided through the cropping pattern *vis-a-vis* farm plus non-farm employment. It is expected that diversification of crops would be beneficial to employment by absorbing larger amount of labour in larger number of crops. But cases have been found in this region where diversification of production and expansion of employment have not gone hand in hand. Rather the opposite has happened. Crop-diversification has been accompanied by lesser employment days. This means that employment does not depend upon mere multiplication of crops but combination of specific crops which are labour-intensive. Ultimately, however, the entire problem turns on net return. A merit of particular cropping pattern is to be assessed with reference to net return derived from it.

III

Contingency X^2 Test of Independence of Association between Number of Crops Grown and Size of Farms

A two-stage stratified random sample of 40 farms from each of North and Central Monghyr was selected from the Farm Management Survey in Bihar[2] for the study of frequency distribution according to size-groups of farms and cropping pattern (or number of crops grown in a year). It is observed that crops in increasing number upto the limit of 5 are cultivated by increasing number of farms upto the size of 7.5 acres. Farms cultivating more crops diminish after this. The test criterion used is the contingency X^2 to test the hypothesis of independence of association between the number of crops grown and the size of farms.

2. *Op. cit.*

The results are presented in Table I.

TABLE I—CONTINGENCY X^2 TEST OF INDEPENDENCE BETWEEN NUMBER OF CROPS GROWN AND THE SIZE OF FARMS

Region	Degree of Freedom	X^2 Observed	X^2 Theoretical (Level of significance)		
			at 5%	at 20%	at 30%
North Monghyr	25	28.27	37.4	30.675	28.172
Central Monghyr	25	29.42	37.4	30.675	28.172

From the results shown above, we have reasons to believe that in no zone is the X^2 test significant at 5 per cent probability level. This clearly indicates that the number of crops to be cultivated has, on the whole, nothing to do with the size of farms. As we move along, the picture changes at 25 per cent probability level when significance appears but then the question becomes whether such a level is practicable. Certainly it is not. If so, it is no use referring to the overall pattern and we rest content with merely the partial tendencies discovered before.

Cropping Pattern and Land Utilisation

But the mere number of crops is not enough to determine the cropping pattern. For this the nature of crops as also the percentage area given to each crop has to be ascertained. This is done in Table II where the proportions of gross cropped area devoted to 7 very important crops of the regions classified according to the number of crop farms in typical sizes are given.

Table II reveals a good deal of difference between North and Central Monghyr in respect of cropping pattern despite similarity in the distribution of farms by number of crops grown and farm size. While in the North zone, the cropping pattern is characterised by far greater importance of crops like wheat plus gram, maize plus *arhar* and maize and less so of paddy, in the other zone paddy dominates the pattern, wheat plus gram and maize recede to the background and the importance of maize plus *arhar* ebbs out. By number of crop farms and farm size, the picture that emerges further differentiates the two zones. Upto the size of 5 acres in North Monghyr, increased proportions of the gross cropped area go to paddy with increase in the number of crops cultivated (from 2 to more than 6 crops) but above that size, the proportion further increases among the usual multi-cropped farms (6 crops or so). It seems that the increase in proportion of paddy is more associated with increase in the size of farms than increase in the number of crops. In Central Monghyr, irrespective of farm sizes, the proportion of paddy acreage decreases as the number of crops practised increases. Maize and maize plus *arhar*, next, taken separately claims a bigger share of the cropping pattern among the few crop farms (than among the many crop-ones) and the enlargement of the farm size has a general tendency to reduce this share consistently in North Monghyr In the other area, maize is not cultivated at all along with *arhar* but instances available for maize (single) seem to indicate that whatever

the farm size, specially the lower size ones, importance of the crop persists generally as long as the number of crops in view is large, say above 5. The same can be said about wheat or wheat plus gram in this zone though in the other area, the farm size has, on the one hand, the effect of emphasizing the importance of wheat plus gram (opposite being the effect in the case of wheat) while number of crops, on the other, has the effect of restricting it in any size group. It is to be particularly noted that the share of wheat plus gram in the total cropped area is the most marked among 2 or 3-crop farms less than 2.5 acres in size and among

TABLE II—PERCENTAGE OF GROSS CROPPED AREA UNDER PRINCIPAL CROPS OF THE CROPPING PATTERN ACCORDING TO THE NUMBER OF CROP-FARMS AND FARM-SIZES, MONGHYR: 1958-59

Size of farms (acres)	No. of crops	Percentage of Gross Cropped Area under						
		Paddy	Maize	Maize & Arhar	Wheat	Wheat & Gram	Chilli	Jowar
1	2	3	4	5	6	7	8	9
		North Monghyr						
2.50	2	—	1.9	54.5	—	38.3	5.2	—
	3	12.9	32.1	11.7	4.7	28.1	—	—
	4	15.1	28.5	9.2	4.7	23.0	—	—
	5	17.0	12.6	14.2	—	24.4	5.1	1.2
	6	14.8	27.9	10.9	17.2	7.8	—	0.3
	Above 6	—	23.6	20.7	8.1	19.7	8.7	5.5
All crops		10.5	24.9	17.8	7.6	18.2	1.9	0.9
5.00	4	27.0	16.4	12.5	—	16.4	—	—
	5	—	46.5	—	12.8	23.3	—	3.4
	6	—	61.1	—	5.3	11.9	—	—
	Above 6	32.6	14.1	2.8	—	13.6	4.8	—
All crops		16.4	30.5	6.6	4.3	17.5	0.5	1.0
7.50	5	—	18.8	17.2	—	32.3	—	—
	6	28.5	15.9	20.2	—	10.3	—	—
	Above 6	16.0	10.0	16.2	1.3	12.2	10.5	4.7
All crops		17.1	13.9	17.8	0.6	15.7	4.7	2.1
10.00	3	45.4	27.3	—	—	27.3	—	—
	Above 6	—	33.8	10.6	—	31.9	—	—
All crops		20.9	30.9	5.7	—	29.8	—	—
20.00	Above 6	27.9	14.1	2.1	—	26.8	4.7	0.2
Above 20.00	„ 6	7.5	27.4	6.1	—	25.1	—	0.03
All Size combined		16.5	19.4	10.0	2.2	21.6	2.3	0.8

(*Contd.*)

1	2	3	4	5	6	7	8	9
		Central Monghyr						
2.50	2	63.5	—	—	—	—	—	—
	3	56.9	—	—	—	—	—	—
	4	41.1	11.6	—	—	—	—	—
	5	29.0	20.3	—	2.6	5.9	2.5	—
All crops		41.5	11.8	—	1.3	3.0	1.3	—
5.00	2	89.6	—	—	—	—	—	—
	3	36.8	8.2	—	—	6.4	28.4	—
	4	25.3	14.4	—	9.8	30.5	3.5	—
	5	46.6	0.7	—	—	4.8	—	—
	Above 6	36.5	13.4	—	2.8	—	3.2	—
All crops		40.4	6.8	—	1.6	8.9	13.1	—
7.50	4	60.8	—	—	—	—	—	—
	5	36.3	9.0	—	—	10.6	—	—
	6	26.2	—	—	7.8	19.7	0.2	—
All crops		37.3	5.6	—	1.9	11.3	—	—
10.00	3	47.5	4.6	—	—	—	—	—
	4	43.7	7.6	—	—	—	—	—
	5	42.8	5.0	—	6.2	4.5	—	—
	Above 6	36.7	19.3	—	7.2	3.2	3.7	—
All crops		41.8	10.9	—	3.8	1.9	1.4	—
15.00	3	37.5	13.2	—	—	11.5	—	—
20.00	Above 6	27.2	18.1	—	5.4	2.7	2.0	—
Above 20.00	5	40.3	—	—	—	22.7	—	—
	6	38.9	—	—	12.6	13.2	—	—
	Above 6	18.1	17.1	—	27.0	6.1	1.5	—
All crops		38.0	5.4	—	11.6	15.1	0.5	—
All Size combined		39.1	8.9	—	5.3	9.5	3.2	—

5 or 6-crop farms above 2.5 acres. Chilli (cash crop) and jowar (fodder crop) in North Monghyr and chilli alone in Central are insignificant in respect of acreage and quite infrequently grown by the many crop farms. It appears that the cropping pattern is influenced partly by the length of period taken and partly by the limitation of area suitable for a crop. Presence or absence of knowledge among the farmers of the comparative profitability of different crops is also a determining factor.[3] A multiple crop farm would not have any opportunity of growing a crop which takes long time to mature. For a particular plot the choice is between quick-maturing multiple crops and long maturing few crops. One or the other set whichever yields larger aggregate profit might be adopted.

3. Discussed in G. C. Mandal, "The Pattern of Input, Output and Net Return in Crop-enterprise in the District of Monghyr (Bihar)" (Unpublished paper).

First Indicator

The above, however, forms an introduction to the problem at hand. We may now attempt a probe into the employment with reference to the balance or imbalance between land leased-in and leased-out and its resultant effect on the reserve of family labour. Table III shows that the position is more of imbalance than its reverse in any zone. Upto 7.5 acres of farm size, there is excess of leased-in over leased-out land, the number of farms taking lease of lands also being greater than those leasing-out. This is obvious in North Monghyr although in Central the farm size can be stretched to 10 or 15 acres to validate the observation. Cases of leasing-in and also leasing-out are absent among the 7.5 to 15 acre farms in North. From 20 acres higher up in both the zones, the practice of leasing-out without any leasing-in is the general rule. It would be interesting to trace how this arises as a device of management of labour along with the desired cropping patterns of the farms in question.

Hired Labour Indicator

The percentage of farms engaging hired labour during the year of cultivation is as high as 80 and 90 per cent in North and Central Monghyr respectively. Combining all sizes but differentiating with respect to number of crop farms, it is further revealed that the level of percentage is higher among the 3 to more than 6 crop-farms than the 2-crop-ones. The basis of computation is the number of farms raising a certain number of crops. On the other basis, *viz.*, number of all farms regardless of the number of crops grown, the tendency is, however, the same, that is, the proportion of hired labour increases with an increase in the holding-size. Bringing now the question of the extent of hired labour expressed in terms of the percentage of the total labour requirement in the off and peak agricultural seasons, it can be concluded from the data that the farms are able to conduct the various operations demanded of the crop pattern without appreciably taxing the available family labour provided the number of crops in view remains less than 5. In North Monghyr, the percentage in the off-season is more than moderate among the 2-crop-farms but yet it does not imply that the capacity point is reached, because with them it is a case of gainful employment opportunities available outside which draw away a section of the working force necessitating the use of hired labour to a substantial extent even in the off-season. In Central Monghyr, although the percentage is not high in the off-season among the 5-crop farms and above compared to the 4-crop farms and below, the corresponding percentage in the peak season among these units is relatively high and the two together suggest that 4-crop cultivation is the limit of labour capacity. In the other zone, the data *a fortiori* support this limit. Let us qualify these remarks with reference to both the number of crops and size of farms. For all intents and purposes, it is hardly any case of capacity point reached for farms in sizes less than 2.5 acres within the range of crops cultivated in North Monghyr although in Central we may speak of it in relation to those cultivating more than 4 crops. The 4-crop limit then applies to farms from 2.5 to 7.5 acres in size (exclusive cases of leasing-out in above 20 acres-farm size are a special point in its defence) in North and above this size, it becomes rather a question of farm size than number of crops that forces enterprise upto the capacity point or a point beyond it. In the other zone, capacity

TABLE III—PERCENTAGE OF FARMS LEASING-IN AND PERCENTAGE LEASING-OUT BY NUMBER OF CROPS GROWN AND FARM-SIZE, MONGHYR: 1958-59

Farms and their cropping pattern :	Percentage of Farms Leasing-in and Percentage Leasing-out															
	—2.50		—5.00		—7.50		—10.00		—15.00		—20.00		Above —20.00		All Sizes	
	L.I.	L.O.	L.I.	L.O.	L.I.	L.O.	L.I.	L.O.	L.I.	L.O.	L.I.	L.O.	L.I.	L.O.	L.I.	L.O.
North Monghyr																
2 Crop Farms	4.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3 „ „	4.5	4.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4 „ „	4.5	—	16.7	—	—	—	—	—	—	—	—	—	—	—	—	—
5 „ „	—	—	—	16.7	—	—	—	—	—	—	—	—	—	—	—	—
6 „ „	9.0	—	16.7	—	—	—	—	—	—	—	—	—	—	—	—	—
Above 6 „	9.0	—	16.7	—	33.4	—	—	—	—	—	—	66.7	—	—	—	—
All Crop Farms	31.5	4.5	50.1	16.7	33.4	—	—	—	—	—	—	66.7	—	—	—	—
Central Monghyr																
2 Crop Farms	12.5															
3 „ „	12.5	—	21.4	—	—	—	—	—	—	—	—	—	—	—	—	—
4 „ „	—	—	14.3	—	—	—	16.7	—	—	—	—	—	—	—	—	—
5 „ „	12.5	—	—	—	42.8	—	—	—	—	—	—	—	—	33.3	—	—
6 „ „	—	—	—	—	—	14.3	—	—	—	—	—	—	—	33.3	—	—
Above 6 „	—	—	—	7.1	—	14.3	—	33.3	16.7	—	—	50.0	—	33.3	—	—
All Crop Farms	37.5	—	35.7	7.1	42.8	28.6	16.7	33.3	16.7	—	—	50.0	—	100.0	—	—

L.I. — Leasing-in
L.O. — Leasing-out

does not seem to be reached until after 6 crops in 2.5 to 5 acres but below 10 acres the 4-crop limit applies. Above 10 acres capacity is purely determined by farm size. It is to be noted that the average level of capacity is attained in Central Monghyr at a much lower level of percentage requirement of hired labour in off and peak seasons than in North. This is so because the available labour force in the former zone is higher on the average than in the latter.

Farm Employment

When much has been said about labour capacity *vis-a-vis* cropping pattern, it is worthwhile to analyse the situation in respect of farm working force, farm employment and the overall unemployment. Farm employment considered here is an account of work that the livestock enterprise provides besides that provided by the cropping programme. The employment or unemployment situation is ascertained with reference to a single male worker. In North Monghyr the working force (male) constitutes all the way between 1 and 2 workers per farm over the whole range of farm sizes. 7.5 acres is a dividing line in the farm size below which the number of male workers is less than 2 per farm and above which it is 2 or slightly greater. In addition, farms of size below 7.5 acres growing a large number of crops are distinguished by a tendency of a slight rise in the number of working members in families. In Central Monghyr, the position is not very different upto 15 acres, but above that size, the difference is significant. It is here that the size of the male working force jumps up and varies between 3 and 7. In short, the figures do not connote that the justification for increased diversification lies in increased working force. It lies elsewhere. Reviewing now the employment and unemployment situation, some remarkable points emerge. First, enlargement of the farm size tends generally to increase the proportion of the total employment accounted for by farm work in both the areas. The proportion, in general, is larger in magnitude in the Central than in the North zone. Second, unemployment days per male worker are lesser in number in the North than in the Central Monghyr. This corroborates the fact of better off-farm employment opportunities being available in North than in Central. Of greater significance is the fact that while in the North zone the number of unemployment days per male worker does not show much of variation from one farm size to another, in the other increase in farm size gives rise to progressive increase in unemployment days. This increase in the extent of unemployment days is closely related to the declining intensity of cropping with the increase in farm size. Unemployment in the case of larger farms appears to emerge as leisurely hours rather than in its pure form.

Income on Crop Account

The various issues raised so far may be re-examined in the light of farm business income (Table IV). It is pointed out incidentally that the farm business income dealt with here does not include the income from the livestock enterprise which ordinarily constitutes an important activity of the farm but is typically the crop income net of variable costs. This, however, fixes the two zones in the order like North preceding Central because, on the average, the farm business income per acre, not to speak of per farm is appreciably larger in the former than in the latter zone. In fact, it is more than 1½ times as large (Rs. 158) in the North as in the Central zone (Rs. 92). Of special interest to us in the previous contexts are

TABLE IV—FARM BUSINESS INCOME PER FARM AND PER ACRE ACCORDING TO NUMBER OF CROPS AND FARM-SIZE, MONGHYR: 1958-59

Farms and their cropping pattern	Farm Business Income Per Farm and Per Acre (in Rupees)															
	—2.50		—5.00		—7.50		—10.00		—15.00		—20.00		Above —20.00		All Sizes combined	
	I.F.	I.A.	I.F.	I.A.	I.F.	I.A.	I.F.	I.A.	I.F.	I.A.	I.F.	I.A.	I.F.	I.A.	I.F.	I.A.
North Monghyr																
2 Crop Farms	222	212	—	—	—	—	—	—	—	—	—	—	—	—	222	212
3 „ „	350	203	—	—	—	—	941	81	—	—	—	—	—	—	424	144
„ „	383	140	962	171	—	—	—	—	—	—	—	—	—	—	631	159
5 „ „	410	184	1962	200	1539	150	—	—	—	—	—	—	—	—	946	176
6 „ „	616	174	1148	253	1745	198	—	—	—	—	—	—	—	—	1015	196
Above 6 „	409	119	543	154	1474	198	2083	154	—	—	2819	167	4399	97	1883	146
All Crop Farms	406	169	1090	188	1575	188	1512	121	—	—	2819	167	4399	97	1020	158
Central Monghyr																
2 Crop Farms	133	101	468	147	—	—	—	—	—	—	—	—	—	—	244	126
3 „ „	99	35	361	55	—	—	1432	70	463	22	—	—	—	—	433	49
4 „ „	—219	—75	908	243	1359	142	—192	—12	—	—	—	—	—	—	612	93
5 „ „	78	20	423	72	271	25	980	77	—	—	—	—	3710	76	592	55
6 „ „	—	—	493	114	737	89	—	—	—	—	—	—	3614	129	1696	115
Above 6 „	—	—	—	—	—	—	1609	158	—	—	4892	169	4115	118	2388	145
All Crop Farms	60	21	513	96	559	57	1175	89	463	23	4892	169	3814	103	886	92

I. F.=Farm Business Income per Farm ; I. A.=Farm Business Income per Acre.

the pictures revealed from each size group in the two areas. Take, for instance, the lowest size group, *i.e.*, less than 2.5 acres. This is the size as found before the farms within which have had no problem of labour capacity as in North or had it where number of crops grown exceeded 4 as in Central. With reference to returns, they now permit a categorisation like farms cultivating 2 or 3 crops in North getting relatively greater net returns than those cultivating beyond 3 crops. The same applies to Central. Moreover, the unemployment days per male worker are considerably lower among the 2 or 3 crop farms in North and 2 crop-farms in Central Monghyr than those lying above in this size group. Could we not ask then why the very small farms resort to increased diversification under the existing condition of farming when the premises of net returns and employment suggest that they should not have done so?[4] Roughly speaking, a recommendation may be made for the cropping pattern which is 34 per cent maize and *arhar*, 33 per cent wheat and gram and the rest maize or some minor adjustments thereof in North and 66 per cent paddy and rest some minor crop or some minor variation thereof in Central Monghyr to be followed by these farms seeking to conciliate the three criteria.

In the size groups from 2.5 to 7.5 acres in North Monghyr where evidences are forthcoming for the farms having crossed the labour capacity point after 4 crops, the fact of relatively greater net return per acre derived by them seems to justify their attempt at increased diversification. This situation cannot, however, be described so much emphatically in Central in the corresponding size groups or a little above, say upto 10 acres because even if the size group 7.5—10 acres presents no trouble, the preceding ones do. In these two size-groups, it is recommended that farms should abandon the practice of cultivating more than 4 crops on first the labour capacity, secondly, the employment and thirdly, the productivity grounds. Above 15 but below 20 acres, the net return per acre on the crop account increases considerably in Central Monghyr though it remains at the same or slightly lower level compared to some of the preceding size groups in North. Above 20 acres, it can be definitely said that the level of net return per acre falls in both the zones. This is an evidence of bigger farms operating at a lower level of efficiency.

It is felt that diversification of crops beyond the point of positive marginal profitability is resorted to by the small farms as a measure of insurance against the risk or crop failure. The reduction of net income on account of cultivating more than three crops mentioned above may be treated as cost of the insurance. An administrative policy which is directed towards encouraging specialization in crop pattern should take in view the help required to enhance the risk-bearing capacity of the small farms and also the necessity of minimizing risks particularly those associated with natural calamities, *e.g.*, droughts and floods and ravages done by pests.

4. The question that specialization might be more profitable than diversification has also been raised in a different setting in an unpublished paper by the author. *Op. cit.*